A2 cancel

2. (Amended) The vertical cavity surface emitting laser of claim 1 further comprising one or more current constriction apertures that inhibit current from being injected into material beneath said reflector.

3. The vertical cavity surface emitting laser of claim 2 wherein said current constriction comprises an ion constriction layer formed by ion implantation within an active layer of said VCSEL.

4. The vertical cavity surface emitting laser of claim 1 further comprising a lateral index guide for controlling modal overlap with said optical loss.

5. The vertical cavity surface emitting laser of claim 4 wherein said lateral index guide comprises oxidation layers.

6. The vertical cavity surface emitting laser of claim 1 wherein said dielectric mirror layers comprise alternating quarter wavelength layers of silicon nitride and silicon dioxide.

7. The vertical cavity surface emitting laser of claim 3 wherein said lateral index guide comprises a thermal lens formed by joule heating from current injection which creates a positive change in index with temperature gradients.

A3

8. (Amended) The vertical cavity surface emitting laser of claim 1 wherein said hybrid mirror further comprises:

a dielectric spacer layer formed on said anti-phase layer, wherein said dielectric mirror layers are distributed across said dielectric spacer layer and said reflector, and wherein total thickness of said anti-phase layer and dielectric spacer is an integer multiple of a half wavelength.

9. The vertical cavity surface emitting laser of claim 4 wherein thickness of a layer between said dielectric mirror and said semiconductor mirror is spatially varied to introduce an effective lateral index guide by shifting cavity mode of said VCSEL without substantially altering cavity loss of said VCSEL.

10. The vertical cavity surface emitting laser of claim 9 wherein said spatial variation of said layer between said dielectric mirror and said semiconductor mirror comprises a step function variation.

11. The vertical cavity surface emitting laser of claim 9 wherein said spatial variation of said layer between said dielectric mirror and said semiconductor mirror comprises a radial variation for single mode operation.

12. The vertical cavity surface emitting laser of claim 4 wherein an upper surface of said semiconductor mirror layer is spatially varied to introduce an effective lateral index guide by shifting cavity mode of said VCSEL without substantially altering cavity loss of said VCSEL.

13. (Amended) A vertical cavity surface emitting laser comprising:

A first mirror formed adjacent to a substrate;

an optical cavity formed adjacent to said first mirror;

a lateral index guide comprising

a hybrid mirror having semiconductor mirror layers;

a dielectric spacer layer formed on said semiconductor mirror layers; and

dielectric mirror layers formed on said dielectric spacer layer, wherein thickness of said dielectric spacer layer is spatially

A4 cont

varied to radially alter resonant cavity wavelength of said VCSEL and thereby providing a lateral index guide.

14. (Amended) The vertical cavity surface emitting laser of claim 13 further comprising:

an anti-phase layer formed on uppermost semiconductor mirror layer, and

an ohmic contact formed on said anti-phase layer, wherein said ohmic contact and said anti-phase layer provide spatially varying optical loss so as to suppress higher order modes.

15. The vertical cavity surface emitting laser of claim 14 further comprising one or more current constriction apertures that inhibit current from being injected into material beneath said ohmic contact.

16. The vertical cavity surface emitting laser of claim 15 wherein said current constriction further comprises an ion constriction layer formed by ion implantation within an active layer of said VCSEL.

17. (Amended) A method of fabricating a single mode vertical cavity surface emitting laser comprising:

forming a first mirror on a substrate;

forming an active layer and cavity on said first mirror layer;

forming a semiconductor mirror on said active layer;

forming an anti-phase layer on said semiconductor mirror layer;

forming an ohmic contact on said anti-phase layer; and

wherein said ohmic contact and said anti-phase layer provide mode selective optical loss to suppress higher order modes.

18. The method of claim 17 further comprising forming one or more current construction apertures to inhibit current from being injected into material beneath said ohmic contact.

19. The method of claim 18 further comprising forming a lateral index guide to control modal overlap with said optical loss.

20. (Amended) A method of fabricating a vertical cavity surface emitting laser comprising:

forming a first mirror on a substrate;

forming an active layer on said first mirror layer;

forming a second mirror on said active layer;

forming a dielectric spacer layer on said second mirror layer;

forming a dielectric mirror on said dielectric spacer layer; and

varying phase of said dielectric spacer layer to form a lateral index guide.

A6

21. (New) A vertical cavity surface emitting laser comprising:

a first mirror formed adjacent to a substrate;

an optical cavity formed adjacent to said first mirror;

a second mirror formed adjacent to said optical cavity; and

a planar anti-phase layer formed adjacent to said second mirror for providing mode selective optical loss to suppress higher order modes.

A6 cont

22. (New) The vertical cavity surface emitting laser of claim 21 further comprising one or more current constriction apertures.

23. (New) The vertical cavity surface emitting laser of claim 2 wherein said each of said one or more current constriction apertures comprise an ion constriction layer formed by ion implantation.

24. (New) The vertical cavity surface emitting laser of claim 21 further comprising a lateral index guide for controlling modal overlap with said optical loss.

25. (New) The vertical cavity surface emitting laser of claim 24 wherein said lateral index guide comprises oxidation layers.

26. (New) The vertical cavity surface emitting laser of claim 24 wherein said lateral index guide comprises a thermal lens formed by joule heating from current injection which creates a positive change in index with temperature gradients.

27. (New) The vertical cavity surface emitting laser of claim 21 further comprising a dielectric spacer layer formed on a first portion of said anti-phase layer, ohmic contacts formed on a second portion of said anti-phase layer, and dielectric mirror layers distributed across said dielectric spacer layer, and wherein total thickness of said anti-phase layer and dielectric spacer is an integer multiple of a half wavelength.

28. (New) The vertical cavity surface emitting laser of claim 21 further comprising a dielectric spacer layer formed on a first portion of said anti-phase layer, ohmic contacts formed on a second portion of said anti-phase layer, and dielectric mirror layers distributed across said dielectric spacer layer, and wherein thickness said dielectric spacer layer is spatially varied to introduce an effective lateral index guide by shifting cavity mode of said VCSEL without substantially altering cavity loss of said VCSEL.

29. (New) The vertical cavity surface emitting laser of claim 28 wherein said spatial variation of said dielectric spacer layer comprises a step function variation.

30. (New) The vertical cavity surface emitting laser of claim 28 wherein said spatial variation of said dielectric spacer layer comprises a radial variation for single mode operation.

31. (New) The vertical cavity surface emitting laser of claim 21 further comprising an ohmic contact formed on said anti-phase layer wherein reflections from said ohmic contact are substantially out of phase with reflections from said second mirror to provide mode selective optical loss.

32. (New) A vertical cavity surface emitting laser comprising:

a first mirror formed adjacent to a substrate;

an optical cavity formed adjacent to said first mirror;

a second mirror formed adjacent to said optical cavity; and

an anti-phase layer formed adjacent to said second mirror for providing mode selective optical loss; and

a lateral index guide that radially alters resonant cavity wavelength of said VCSEL for controlling modal overlap with said optical loss.

33. (New) The vertical cavity surface emitting laser of claim 32 further comprising one or more current constriction apertures.

34. (New) The vertical cavity surface emitting laser of claim 33 wherein said each of said one or more current constriction apertures comprise an ion constriction layer formed by ion implantation.

35. (New) The vertical cavity surface emitting laser of claim 32 wherein said lateral index guide comprises oxidation layers.

36. (New) The vertical cavity surface emitting laser of claim 32 wherein said lateral index guide comprises a thermal lens formed by joule heating from current injection which creates a positive change in index with temperature gradients.

37. (New) The vertical cavity surface emitting laser of claim 32 further comprising an ohmic contact formed on said anti-phase layer wherein reflections from said ohmic contact are substantially out of phase with reflections from said second mirror to provide said mode selective optical loss.

38. (New) The vertical cavity surface emitting laser of claim 32 further comprising a dielectric mirror formed on said anti-phase layer wherein reflections from said dielectric mirror are substantially out of phase with reflections from said second mirror to provide mode selective optical loss.

39. (New) The vertical cavity surface emitting laser of claim 32 wherein said lateral index guide comprises a dielectric spacer layer formed on said second mirror and dielectric mirror layers formed on said dielectric spacer layer, wherein thickness of said dielectric spacer layer is spatially varied to radially alter resonant cavity wavelength of said VCSEL.

40. (New) The vertical cavity surface emitting laser of claim 38 wherein said spatial variation of said dielectric spacer layer comprises a step function variation.

41. (New) A vertical cavity surface emitting laser comprising:
a first mirror formed adjacent to a substrate;
an optical cavity formed adjacent to said first mirror;
a second mirror formed adjacent to said optical cavity; and

a hybrid mirror formed adjacent to said optical cavity comprising,

semiconductor mirror layers,

an anti-phase layer formed adjacent to said semiconductor mirror layers for providing mode selective loss to suppress higher order modes and for defining lateral extent of said optical cavity,

dielectric mirror layers deposited on said anti-phase layer.

42. (New) The vertical cavity surface emitting laser of claim 41 further comprising an ohmic contact formed on said anti-phase layer wherein reflections from said ohmic contact are substantially out of phase with reflections from said second mirror to provide said mode selective optical loss.

43. (New) The vertical cavity surface emitting laser of claim 41 further comprising a dielectric spacer layer formed on said anti-phase layer wherein reflections from said dielectric spacer layer are substantially out of phase with reflections from said second mirror to provide mode selective optical loss.

REMARKS

Claims 1-20 are currently pending in this application. Claims 1, 2, 8, 13, 14, 17 and 20 have been amended for clarity and claims 21-43 have been added to claim additional subject matter to which applicant is entitled. Applicants have also amended the specification to correct typographical errors therein. The amendments to the specification add no new matter.

Accordingly, applicants respectfully request entry of the present amendment and examination and allowance of this application.